Smile Judgment in Substance Use Disorders and its Relationship to Interpersonal and Emotional Functioning: An Eye-Tracking Investigation

by

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Abstract

The current study explored the judgments individuals with Substance Use Disorders (SUDs) make regarding the authenticity of enjoyment smile expressions and masking smile expressions containing traces of negative emotions. Accuracy at identifying the masked negative emotions were also examined. Eye-movements were recorded to observe relationships between attentional processes and smile judgment. Additionally, the relationship between smile judgment, emotion dysregulation, and interpersonal problems were also investigated. Twenty individuals with SUDs being treated from a local treatment center and twenty individuals matched on gender/age participated in the smile judgment task, which involved a smile expression characteristic of enjoyment and six smile expressions containing traces of either fear, disgust, anger in eyes, anger in mouth, sadness in eyes, and sadness in mouth. Results indicated that individuals with SUDs were no different in their categorization of the smiles. The lack of difference may be due to their previously observed biases at interpreting expressions as negative, as the results indicated that individuals with SUDs were significantly more likely to report the presence of negative emotions in the expressions. They were also more often incorrect in their identification of the masked emotions. No link was observed between smile judgment and attentional processes. Emotional and interpersonal functioning were related more to the ability to distinguish smile authenticity than the ability to identify masked emotions.

Keywords: Substance use, smile judgment, eye-tracking, emotional-interpersonal

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Chapter 1: Introduction

Substance use disorders (SUDs) are pervasive conditions whereby the use of one or more substances leads to clinically significant impairments in daily functioning and/or experiences of distress (Diagnostic and Statistical Manual of Mental Disorders-5, 2013). The persistent brain alterations that are inherent in this condition are associated with significant behavioural, cognitive, and emotional difficulties (Diagnostic and Statistical Manual of Mental Disorders-5, 2013; Goldstein & Volkow, 2002; Verdejo-Garcia & Bechara, 2009). Given these difficulties, it is no surprise that research suggests that individuals with SUDs experience greater difficulties with respect to emotion regulation, and in effect, interpersonal functioning (Daley, 2013; Khantzian, & Albanese, 2008; Legenbauer, et al., 2016; Whisman, 2007; Wilens et al., 2013).

Both emotion regulation and positive interpersonal relationships entail the accurate interpretation and recognition of verbal and non-verbal emotional signals in both self and others (Patterson, 1999; Carton, Kessler, & Pape, 1999). Unfortunately, part of the difficulty individuals with SUDs often face with respect to emotion regulation and interpersonal relations could be their deficits in the cognitive processing of non-verbal emotional signals (Philippot et al., 1999; Kornreich et al., 2002, 2003). For instance, it has been shown that these individuals have deficits in their ability to correctly interpret facial expressions of emotion (Philippot, et al. 1999; Kornreich et al., 2002, 2003; Townshend & Duka, 2003; Fernandez-Serrano, et al., 2010; Foisy, et al. 2007; D'Hondt, de Timary, Bruneau, & Maurage, 2015). Specifically, these individuals have been found to identify emotional facial expressions less accurately than normal controls (Kornreich et al., 2002; Kornreich et al., 2003; Foisy et al., 2007; Philippot et al., 1999), have a

tendency to overestimate the intensity of emotion in facial expressions (Philippot et al., 1999; Kornreich et al., 2001), require a greater intensity of nonverbal cues to perceive the emotion as being present in an expression (Frigerio et al., 2002), and have a specific bias towards perceiving facial expressions as hostile (Philippot et al., 1999; Townshend & Duka, 2003). These deficits have been observed in both recently detoxified individuals as well as mid- to long-term abstinent individuals (Foisy et al., 2007; Kornreich et al., 2001).

The goal of the current study was to conduct a systematic examination of the judgment of smile authenticity and the recognition of traces of negative emotions in smiles in individuals with SUDs. The differences that occur in the judgment of the smile expressions as a function of the negative emotion and the area of the face in which it is presented (eyes, nose, or mouth area) was also explored. Additionally, eye-movement measures were recorded during the judgment task in an effort to observe the perceptual-attentional mechanisms employed by individuals with SUDs when interpreting the smile expressions, which to the best of our knowledge has never been explored. Finally, the relationship between smile judgement, emotion recognition, and both emotion dysregulation and interpersonal problems were also explored in the current study.

1.1 Production of Enjoyment and Masking Smile Expressions

The smile is known to be one of the most frequently expressed facial expressions during interactions with others and is often recognized as a sign of happiness or enjoyment (Abel, 2002). Although smiles may occur genuinely during instances of enjoyment or happiness, the smile may also be voluntarily expressed in the absence of positive emotions, for example, when being polite, when indicating to another that you

are listening, and when attempting to deceive or manipulate others (Ekman, 2003, 2001; Thibault et al., 2009). Smiles that have been associated with enjoyment have been reported as containing the activation of both the zygomatic major muscle, which pulls the corner of the lips upwards into a smile, and the orbicularis oculi muscle, which causes the lifting of the cheeks, narrows the eye-opening, and causes wrinkles around the eye sockets (Ekman et al., 1990, 2002; Duchenne, 1990; Ekman, 2003; Frank, Ekman & Friesen, 1993). Additional factors that contribute to the perception of an enjoyment smile include smile symmetry, increasing intensity of muscle contraction, and longer apex durations (Gosselin, Perron, Legault, & Campanella, 2002; Krumhuber & Manstead, 2009; Gunnery & Ruben, 2016; Perron & Roy-Charland, 2013). These variables contribute to greater judgments of smile authenticity and positive ratings even when using static as opposed to dynamic stimuli in judgment tasks (Gunnery & Ruben, 2016).

In addition to expressing felt enjoyment, smile expressions may also serve to mask negative emotions. Masking smiles occur when individuals attempt to conceal a negative emotion with a smile. They have specifically been documented as comprising the activation of the zygomatic major and/or the orbicularis oculi, in addition to the activation of muscles associated with the emotion of fear, sadness, anger, disgust, or contempt (Ekman, Friesen, & O'Sullivan, 1988). While attempting to conceal or 'mask' a negative emotion with a smile, the strategies are not always perfect, and traces of the negative emotion may leak into the smile expression causing what has been referred to in the literature as microexpressions (Ekman, et al., 1988). Microexpressions occur because certain facial muscles activated during the true experiences of an emotion are difficult to consciously and voluntarily simulate and these same muscles are difficult to inhibit and

control when attempting to mask a felt emotion (*Inhibition Hypothesis,* Ekman, 2003; Ekman and O'Sullivan, 2006; Duchenne, 1862/1990; Ekman, Roper & Hager, 1980; Gosselin, et al. 2011; Gosselin, Perron & Beaupre, 2010). Microexpressions are very brief and small muscular movements of the face that are manifested in either the upper or lower half of the face at one time (Porter & ten Brinke, 2008; Porter, ten Brinke, & Wallace, 2012). Additionally, they are more likely to occur when individuals experience strong emotional reactions as opposed to low emotional reactions, and the quick activations of facial muscles have been found to be congruent with the felt emotion (ten Brinke, Porter, & Baker, 2011).

1.2 Recognition of Enjoyment and Masking Smile Expressions

Past research indicates that individuals are sensitive to smiles that are associated with enjoyment and smiles that serve some other communicatory function, such is the case with masking smile expressions (Perron & Roy-Charland, 2013; Perron et al., 2016; Miles & Johnston, 2007; Krumhuber & Manstead, 2009; Calvo et al., 2008a, 2008b; Slessor et al., 2010). Gosselin and colleagues (2002) examined the ability that children (aged 6-7 and 11-12 years) and adults had at distinguishing between enjoyment smiles that contained the activation of both the orbicularis oculi and zygomatic major muscles, and masking smiles containing traces of anger, which were produced with the simultaneous activation of the zygomatic major, the lip corner puller, and the lip tightener (action units that have been found to be part of anger expressions). Participants were expected to respond with "really happy" for the enjoyment smiles and "pretending to be happy" for the masking smile expressions containing traces of anger. Moreover, participants were required to label the masked emotion by choosing the correct emotion

label from a list when they felt the stimulus image was “pretending to be happy”. This task was thought to infer the participants’ explicit knowledge about anger as the hidden emotion.

Results indicated that participants as young as six years could distinguish the enjoyment smile expressions from the masking smile expressions. Children aged six-seven years produced the expected response of “really happy” significantly more often for enjoyment smiles that contained the activation of the orbicularis oculi and zygomatic major than for smiles containing the lip tightener. Children aged eleven-twelve years also produced the expected response of “really happy” significantly more often for the enjoyment smiles that contained the activation of the orbicularis oculi and zygomatic major than for the smiles containing the lip tightener. Interestingly however, none of the children (6-12 years) could accurately label the masked emotion as anger when required to do so. Children aged six-seven years could only name the hidden emotion as anger twenty-nine percent of the time while children aged eleven-twelve could label the hidden emotion as anger thirty-one percent of the time. Adults were also able to distinguish between the enjoyment smiles and masking smiles, doing so at significant levels. With regards to explicit knowledge about anger as the hidden emotion, adults only accurately labeled the hidden emotion as anger fifty percent of the time, suggesting that explicit knowledge may develop later in an individual’s development but that the task still presents with some difficulty.

Perron and colleagues (2016) extended on the previous research by including traces of not only anger, but also sadness, disgust, and fear. Moreover, they included expressions that contained traces of the negative emotions presented in either the eye or

mouth area. Thus, in addition to smiles that were characteristic of enjoyment, they included masking smile expressions that contained traces of anger with characteristics presented in the eye area, anger with characteristics presented in the mouth area, disgust with characteristics presented in the nose area, fear with characteristics presented in the eye area, sadness with characteristics presented in the eye area, and finally a masking smile containing traces of sadness presented in the mouth area. They also examined eye-movements during the task in an effort to understand the perceptual-attentional mechanisms underlying participant's judgments, meaning they wanted to understand what the participants perceived and attended to while viewing the various stimuli. It was hypothesized that if the judgment of the masking smile expressions relied on perceptual-attentional processing then accuracy on the judgment task would increase as attention was allocated to the area of the expression where the traces of the negative emotions were presented.

Their results revealed that individuals could distinguish the authenticity of smile expressions as they produced the expected response of "really happy" significantly more often for the enjoyment smiles than the masking smile expressions. Nevertheless, while individuals could distinguish the authenticity of the smile expressions, results were in some cases modest, thus suggesting that there is some difficulty associated with the task. Moreover, variations in judgment were observed as a function of both the traces of negative emotions as well as whether the negative characteristics were presented in the eye or mouth area. For instance, accuracy was highest for smile expressions masking fear than any of the other masking smile expressions. Moreover, accuracy was higher for smiles masking anger when the traces were presented in the mouth than when it was

presented in the eye area. Furthermore, participant's results regarding accuracy at labeling the dissimulated emotions were modest and indicate difficulty regarding the task. For smiles containing traces of fear and those containing traces of sadness in the mouth, accuracy only reached chance levels. While the other masking smile expressions (anger, sadness in Eye, and disgust) reached higher than chance levels, their performances were still modest. Moreover, no link was observed between time spent in the area of the expression that contained the traces of negative emotions and performance on the judgment task, so difficulty in making judgments regarding the smile expressions was not attributed to any perceptual-attentional limitations. While individuals from these studies could accurately judge the authenticity of these smile expressions and could accurately identify some of the dissimulated negative emotions better than chance levels, individuals from clinical populations may not fare as well in such judgment tasks.

1.3 Emotional Facial Expression Recognition in Substance Use Disorders

A few studies have examined emotional facial expression recognition in those with SUDs and have found that they indeed have deficits in their abilities to accurately decode emotional facial expressions. However, most of the studies that have examined emotion recognition in individuals with SUDs have focused on macroexpressions (Kornreich et al, 2001, 2002, 2003; Philippot et al. 1999; Fernandez-Serrano et al., 2010; Foisy et al., 2007; Townshend & Duka, 2003; D'Hondt et al., 2015; Verdejo-Garcia & Bechara, 2009), and no research has been done to explore the judgements individuals with SUDs make when interpreting microexpressions of emotion. Research has shown that individuals who have used and depended on alcohol, opiates, methadone, cocaine, as well as polysubstance users all experience similar deficits in their abilities to decode

macroexpressions of emotion (Kornreich, et al., 2003; Fernadez-Serrano et al., 2010; Verdejo-Garcia & Bechara, 2009), but would the same be said for judgments regarding microexpressions? Specifically, no studies have examined the abilities that individuals with SUDs have in distinguishing enjoyment smile expressions from masking smile expressions that contain traces of negative emotions, and their ability to identify the masked negative emotions in the smile expressions.

With respect to masking smile expressions, the parameters of the characteristics of the differing emotions (enjoyment and the negative emotion) are extremely subtle and more difficult to interpret presenting as a complex decoding task even for healthy individuals (Perron et al., 2016; Gosselin et al., 2002). While no studies have used microexpressions in the judgment tasks with individuals with SUDs, another study done by Townshend and Duka (2003) did explore the impairments and biases that individuals recovering from alcoholism had when decoding morphed expressions of emotions.

Using images of the six basic emotions (happiness, surprise, fear, sadness, disgust, and anger), they morphed two of the emotional expressions together and had participants rate how much of each of the six emotions they judged to be present. A score sheet was presented to participants with a five-choice categorical scale (‘not at all’, ‘a little’, ‘half’, ‘very much’, and ‘completely’) on which the participant had to rate the amount of each of the six emotions. Judgements made by the individuals recovering from alcoholism were compared to those made by a control group matched on gender, age, and education level. Their results indicated that the individuals recovering from alcoholism had significantly over estimated the intensity of the amount of fear expressed in all of the stimuli. Moreover, the two groups differed on many of their judgments regarding anger

and disgust. Misinterpretations of the emotional expressions of fear and anger are important when one considers psycho-evolutionary theories, which posit that the ability to decode emotional expressions associated with negative emotions of anger and fear would have immense adaptive value (Hess & Thibault, 2009). These difficulties that individuals with substance use disorders experience in the judgment of these expressions could be maladaptive and could contribute to the interpersonal difficulties experienced by said group.

Results from the previously mentioned study cannot be generalized to microexpressions, as the morphing of the two macroexpressions is not considered to be a microexpression. In effect, the results from the previously mentioned study may not ecologically valid with respect to microexpressions of emotion. In addition, previous studies have indicated that with respect to healthy individuals, patterns of rating differ in the judgment of macroexpressions and microexpressions. For instance, anger is typically the most accurately recognized macroexpression of emotion in emotional facial expression recognition tasks (Beaudry et al., 2014; Calvo & Lundqvist, 2008). However, the opposite pattern has been observed in studies exploring the judgment of authenticity of smiles containing traces of negative emotions, such that smile expressions that mask anger (in the eye area) are the least accurately judged expressions (Perron et al., 2016; Gosselin et al., 2002). Moreover, macroexpressions of fear are typically the least accurately recognized emotional expression in recognition tasks, but in studies that explore the judgments of authenticity in masking smile expressions (microexpressions), the expressions that contain traces of fear were the most often accurately judged as being non-authentic (Beaudry et al., 2014; Calvo & Lundqvist, 2008; Perron et al., 2016). Thus,

the present study will allow for a better understanding of how individuals with SUDs judge the authenticity of enjoyment and masking smile expressions when compared to normal controls. Moreover, the current study is the first to explore how individuals with SUDs interpret microexpressions of emotion, more specifically, masking smile expressions containing traces of fear, sadness, anger, and disgust.

1.4 Emotion Dysregulation and Emotional Facial Expression Judgment

As mentioned previously, SUDs have been related to many emotional difficulties. One such example is that individuals with SUDs have been shown to experience greater difficulties regulating their emotions (Savov & Atanassov, 2013; Schore, 2003). Emotion dysregulation describes the inability to regularly use healthy strategies when moderating negative emotions (Rolston, & Lloyd-Richardson 2017). As it pertains to SUDs, emotion dysregulation has been shown to be both a pre-existing risk factor for SUDs and a key mediator of ongoing drug use and relapse (Kober, 2014).

Emotion regulation and emotional facial expression recognition are both closely related. In fact, research suggests that the ability to recognize emotion is first required prior to the ability of regulating emotion because the regulation of emotion first requires an understanding and recognition of emotion in self and others (Izard, 2001a; Izard, 2011b; Lane, et al., 2001). If emotion recognition is a precursor to emotion regulation, then a positive relationship between emotion recognition and emotion regulation should be observed. As it relates to individuals with SUDs, it may be expected that those with deficits in their ability to accurately interpret the smile expressions will show greater difficulty in their ability to regulate their emotions. To the best of our knowledge, no study has explored the relationship between emotion regulation and emotional facial

expression recognition in SUDs. However, studies have explored the relationship between emotional facial expression recognition and emotion regulation in other populations (including clinical populations) and have found that a positive relationship does exist (Elfenbein, Marsh, Ambady, 2002; Kucharska-Pietura et al., 2004; Legenbauer, et al., 2016; Yoo, Matsumoto, & LeRoux, 2005; Zonnevylle-Bender et al., 2004).

1.5 Interpersonal Problems and Emotional Facial Expression Judgment

In addition to emotion regulation, effective interpersonal relations also rely on the ability to accurately recognize the emotional states of both self and others (Marsh, Ambady, Kozak, 2007; Wang, 2009). Specifically, in order for communication to occur smoothly, the individuals communicating must accurately recognize and interpret both the non-verbal (i.e. facial expressions, body posture, gestures etc.) and verbal emotional signals (Carton, Kessler, & Pape, 1999; Patterson, 1999). With respect to those with SUDs, research has shown that they often experience interpersonal issues because difficulties with interpretation and expectations arise while attempting to relate to and interact with others (Lander, Howsare, & Byrne, 2013; Unger, Sussman, & Dent, 2003). These difficulties may be related to their deficits in correctly interpreting facial expressions of emotion. Since the accurate interpretation of non-verbal processes are inherent in effective communication, and individuals with SUDs often experience difficulty in recognizing emotional expressions, a relationship may exist between facial expression recognition accuracy and interpersonal functioning.

A study done by Kornreich and colleagues (2002) examined the abilities that individuals with alcoholism had in recognizing macroexpressions of five basic emotions

(anger, sadness, fear, disgust, and happiness). Moreover, they explored the relationship between emotional facial expression judgment and interpersonal problems. They hypothesized that individuals with alcoholism would have deficits in their abilities to identify the emotional facial expressions when compared to a control group. Moreover, it was hypothesized that these deficits in emotional facial expression recognition would be associated with greater interpersonal problems.

The expressions used in the study were selected from a series of standardized emotional facial expressions created by Matsumoto and Ekman. Participants were required to rate the expressions on 7-point scales representing an increase in perceived expression intensity. An expression was considered accurately identified when the highest rating was given on the scale that contained that target emotion since each expression was rated on all five scales (anger, sadness, fear, disgust, and happiness). The evaluation of interpersonal problems was done through the administration of the Inventory of Interpersonal Problems (IIP), which is a self-report instrument that identifies a person's most salient interpersonal difficulties. The eight factors used to explore an individual's interpersonal functioning on the IIP include: domineering/controlling, vindictive/self-centered, cold/distant, socially inhibited, non-assertive, over accommodating, self-sacrificing, and intrusive/needy.

The results indicated that compared to the normal controls, the recently detoxified individuals showed significantly lower accuracy scores for all the emotional expressions. Accuracy scores were greatest for the happiness expressions, followed by sadness, disgust, and anger for both the recently detoxified alcoholics and the control group. Moreover, the recently detoxified individuals showed significantly higher levels of

interpersonal problems when compared to normal controls. Additionally, correlational analyses revealed a significant negative correlation between emotional facial expression decoding and interpersonal problems. In other words, greater accuracy at the emotion recognition task was related to lower levels of interpersonal problems. In effect, individuals recovering from alcoholism present with greater deficits in the decoding of the emotional facial expressions, and this decoding deficit may be related to their experienced interpersonal problems. The current study furthered examined the relationship between interpersonal problems and emotional facial expression recognition in SUDs. More specifically, the relationship between interpersonal functioning and both judgment of smile authenticity and judgment of negative emotions in masking smile expressions were explored as a function of both SUDs and healthy controls.

1.6 Eye-Movements and Emotional Facial Expression Judgment

While the ability to interpret the emotional facial expressions of others is a beneficial skill to possess, the ability to perceive and extract accurate meaning from different expressions first requires an awareness and attention to the subtle and complex cues that are associated with the expressions (Ekman & Friesen, 1975; Ekman & Friesen, 1986). The use of eye-tracking during the judgment task in the current study allowed for an examination of which of these specific parameters of the expression the individuals perceive and allocated their attention towards while the various smile expressions were being interpreted. This is important, as one possible explanation for the difficulty individuals with SUDs face with respect to their interpretation of emotional facial expressions could be difficulty in perceiving or a lack of attention to the cues that are associated with the emotional expressions. For instance, it might be expected that accuracy

in the judgment of the expressions would increase as attention is allocated to the areas of the expressions where the trace of negative emotion is presented.

While Perron et al (2016) found no link between accuracy at this smile judgment task and perceptual-attentional processes in healthy individuals, the same may not be said for those with SUDs. Research indicates that emotional facial expression recognition deficits in many clinical populations are related to atypical visual scanning strategies during the gathering of emotional cues from the face (Clark et al., 2013; Lee et al., 2011; Loughland et al., 2002a; 2002b; Perron et al., 2017; Wilson, Palermo, & Brock, 2012). For instance, studies of emotional facial expression recognition in individuals with schizophrenia reveal a bias for attending to the mouth region when interpreting expressions of fear whereas healthy controls are more likely to use visual information from both the mouth and eye regions (Clark et al., 2013). The current study will contribute to an understanding of the perceptual-attentional processes that those with SUDs employ in the judgment of enjoyment smiles and masking smiles with traces of negative emotions.

1.7 The Current Study

Many studies have examined the ability that individuals with SUDs have in decoding full-faced expressions of emotions (macroexpressions) yet no studies have examined their judgment of authenticity of enjoyment and masking smile expressions (microexpressions) nor have they examined their ability to recognize traces of negative emotions within masking smile expressions. The current study examined the differences that occur in the judgment of enjoyment smiles and masking smiles containing traces of anger, fear, sadness, and disgust in either the upper or lower area of the face. Additionally, judgments were compared to the judgments of individuals from a control

group who were matched on gender and age. In line with the Perron study (2016), it is hypothesized that the control group would be able to discriminate the authenticity of enjoyment and masking smiles containing traces of negative emotions. While no studies have yet to examine the judgment of the authenticity of smiles in individuals with SUDs, it is hypothesized that the individuals with SUDs would perform worse in the authenticity judgment task given their previously observed deficits in the processing of emotional cues and decoding of emotional facial expressions.

If results are similar to those obtained from the Perron (2016) study then it would also be expected that differences will be observed as a function of the trace of negative emotion as well as where the trace of negative emotion is located in the expression. With respect to the individuals with SUDs, studies have shown that recently detoxified individuals with alcoholism or opiate addictions tend to have alterations in their recognition of happiness, fear, anger, and disgust (Foisy et al., 2007; Kornreich et al., 2001; Townshead & Duka, 2003) and have been shown to have a poorer recognition of sadness (Frigerio et al., 2002). Given what we know about their patterns of recognition of microexpressions, we might expect similar impairments in their recognition of the traces of negative emotion within the masking smile expressions. Like mentioned previously, research regarding microexpressions has indicated that traces of negative emotions manifest themselves in either the upper or lower part of the face at one time but that they more frequently occur in the upper part of the face (Porter & tenBrinke, 2008; Porter, tenBrinke, & Wallace, 2012), which could impact the judgment of the authenticity of emotional facial expressions. To examine this, the differences in sensitivity to traces of

negative emotions in the mouth as well as the eye area were also explored in the current study.

Another goal of the current study was to conduct an examination of the perceptual and attentional mechanisms used by individuals with SUDs while decoding the smile expressions, which to the best of our knowledge has also never been explored. The recording of eye-movements during the judgment task allows for the direct exploration of how attention is allocated to the traces of negative emotions in the smile expression. The smile expressions masking anger in the eye area for instance, would be decoded best if individuals perceived and attended to this area of the expression. Individuals with SUDs may have limitations in using such strategies when making judgments regarding the expressions. It is hypothesized that the individual's with SUDs may have perceptual-attentional limitations when processing the characteristics associated with the negative emotions being masked in the smile expression, meaning their judgment may be limited because they may not perceive or allocate their attention towards the subtle muscular movements of the face that are associated with the negative emotion expression. Moreover, they may show more atypical scanning strategies and require more time to make judgments.

The relationship between smile judgement, interpersonal problems, and emotion regulation were also explored in the current study. While no studies have explored the relationship between smile judgment and emotion dysregulation in SUDs, it was expected that greater emotional dysregulation would be related to greater difficulties in emotion recognition as this has been shown to be the result in other clinical populations who experience difficulty regulating emotions (Elfenbein, Marsh, Ambady, 2002; Kucharska-

Pietura et al., 2004; Legenbauer, et al., 2016; Yoo, Matsumoto, & LeRoux, 2005; Zonnevylle-Bender et al., 2004). With respect to the relationship between smile judgment and interpersonal problems, if the results remain similar to the Kornreich study (2002), then it would be expected that the individuals with SUDs would present with more interpersonal problems than individuals from the control group. Additionally, it might be expected that greater interpersonal problems were related to greater deficits in smile judgment. This hypothesis is in line with interpersonal theories, which suggest that interpersonal problems may arise when difficulties with interpretation in communication occur (Horowitz, Dryer, & Krasnoperova, 1997). With respect to emotional facial expression recognition, interpersonal problems may then arise with the misinterpretation of emotional expressions during the communication with others.

The ability to correctly interpret emotional facial expressions may aid in the maintenance of healthy emotion regulation strategies, and interpersonal relationships. In effect, the difficulties individuals with SUDs experience with emotion regulation and interpersonal functioning may be closely related to their emotion recognition deficits. Studies such as this can further guide our understanding of the relationship between SUDs and emotion recognition, and can be used to aid in the creation of emotional-social skills programs for individuals with SUDs that teach them to accurately interpret emotional facial expressions.

Chapter 2: Method

2.1 Participants

All decoders reported normal or corrected-to-normal vision. The SUDs group consisted of 20 individuals (7 men and 13 women, M= 30.85 years) being treated (8

outpatient and 12 inpatient) with a local addictions treatment center and who were not receiving any psychotropic medication at the time of their assessment and treatment. The Control group consisted of 20 individuals (7 men and 13 women, M= 30.85 years) from the community matched on gender and age with the participants from the SUDs group and who have had no prior history of a SUD and other mental health disorders. All participants were required to fill out a demographic questionnaire where they indicated their age, gender, visual acuity, and if they currently have, or have ever had a diagnosis of a mental disorder. With respect to the exclusion criteria, individuals from the Control group were excluded if they had a history of psychiatric illness or were currently in treatment requiring psychiatric medication. For the SUDs group, they were excluded if they had a recent history of epilepsy, neurological disorders, intellectual disabilities, poor visual spatial abilities, significant ocular pathologies, or head injuries. Also excluded were those taking lithium, diazepam, phenytoin, and barbiturates due to their effects on the oculomotor system.

2.2 Material

2.21 Stimuli Seven different smile prototypes were used in the judgment task (1 enjoyment smile and 6 masking smiles containing trace of anger, disgust, fear, or sadness)

Figure 1. Sample of Stimuli

Happiness
(AUs 6+12)

Fear
(AUs 1+2+4+6+12)

Angry Mouth
(AUs 6+12+24)

Angry Eyes
(AUs 6+12+4)

Disgust
(AUs 6+9+12)

Sad Eyes
(AUs 1+4+6+12)

Sad Mouth
(AUs 6+12+15)

Example of the Enjoyment smile (zygomatic major and orbicularis oculi activated symmetrically at the intensity level of C) is presented in the top panel. Examples of the six different masking smile prototypes are presented in the lower panels and included characteristics of the enjoyment smile (activation of AU6 + AU12) with traces of fear, anger, sadness or disgust (the activations of each expression is presented below the image). The traces of negative emotions were produced at an intensity level of B to reflect the subtleness of the activations within microexpressions.

The same stimuli were used in the Perron et al. (2016) study. The Enjoyment smile is characterized by the activation of the orbicularis oculi muscle (AU6) and the zygomatic major muscle (AU12) at the intensity level of C. The other six smiles used were created to represent masking smiles and contained characteristics of the enjoyment smile (AU 12 and AU 6) as well as traces of fear, anger, sadness or disgust. The smile containing the microexpressions of fear used additional activations of the Brow Lower (AU 4), the Inner Brow Raiser (AU 1), as well as the Outer Brow Raiser (AU 2). To depict anger two different smiles were used, one that contained anger in the brows and the other contained anger in the mouth. The smile containing anger in the brows required the additional activation of the Brow Lower (AU 4) while the smile containing anger in the mouth required the additional activation of the Lip Presser (AU 24). Two types of smiles containing traces of sadness were used. The first smile had the trace of sadness in the eyebrow area and contained the activation of both the Brow Lower (AU 4) and the Inner Brow Raiser (AU 1). The second smile contained the trace of sadness in the mouth area requiring activation of the Lip Corner Depressor (AU 15). Finally, the last smile with the trace of disgust contained the Nose Wrinkler (AU 9).

The seven types of smiles used within this study were all coded in accordance with the Facial Action Coding System (FACS). No emotions were induced during the production of the smile expressions but instead the encoders were shown pictures of facial expressions containing the target AUs and were asked to practice the production of the target muscular activations while looking through a mirror with the guidance of a trained and certified FACS coder. The encoders consisted of three men and three women. For each type of smile four different encoders were used producing a total of 28 pictures.

Only smiles that exacted 100% inter-rater agreeability following an evaluation by two qualified FACS coders were chosen for this study. While the stimuli material obtained in such a manner may be considered artificial, doing so ensures that the physical parameters of the smile expressions are controlled for (i.e. activation of correct action units and predetermined intensity levels). Moreover, controlling for the physical parameters of the expression is important because it ensures that the specific physical parameters that the participants were sensitive to could be identified (see Gosselin et al. 2002 for further explanation). This is important because the current study examines the differences that occur in the judgment of the masking smile expressions as a function of the trace of negative emotion as well as where the characteristics associated with the negative emotion is located (i.e., eyes, nose, or mouth area).

2.22 Scales and Inventories As an extra control measure to ensure that individuals from the Control group had no history of or current substance use problems, all participants completed the Simple Screening Instrument for Substance Abuse (SSI-SA), which is a brief, but reliable and valid 16-item questionnaire developed for the screening of substance abuse and dependence. Item endorsement with a total score greater than four entails that further substance use assessment is warranted.

Following the (SSI-SA), participants completed the Becks Depression Inventory-II (BDI-II), which is a widely used and clinically sensitive instrument for detecting depression (Beck, Steer, & Brown, 1996). The BDI-II consists of 21-items that assess the intensity of depression in both normal and clinical patients, takes only five minutes to complete, and is in line with the depression criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). Each of the 21-items consists of four statements

that are arranged from 0-4 representing increases in severity about a particular symptom of depression. The BDI-II was tested on a large clinical sample (N=500) and has excellent construct validity with a coefficient alpha of .90 (Beck et al. 1996; Wang & Gorenstein, 2013).

Participants also completed the Beck's Anxiety Inventory (BAI). The Becks Anxiety Inventory (BAI) is a tool used widely to screen for anxiety and anxiety related disorders. The BAI consists of 21 items that are rated on a scale from 0 to 3 and relate to subjective, somatic, or panic-related symptoms of anxiety (Beck, Epstein, Brown, & Steer, 1988). It has been found to discriminate between anxious and non-anxious groups, and has been found to be sensitive to groups with individuals who have been diagnosed with panic disorder with agoraphobia, panic disorder without agoraphobia, social phobia, obsessive-compulsive disorder, and generalized anxiety (Beck, Epstein, Brown, & Steer, 1988; Muntingh, et al. 2011). The BAI also has a high internal consistency (Cronbachs α = .92), and test-retest reliability over one week of .75 (Beck, Epstein, Brown, & Steer, 1988). The anxiety and depression inventories were added to control for their effects in the accuracy of the judgment tasks. Previous research has indicated that many substance use disorders may be comorbid with anxiety and/or depression (Burns & Teeson, 2002), thus the comorbidity of these disorders may also contribute to the deficits in emotional facial expression decoding in substance use disorders.

All participants completed the Inventory of Interpersonal Problems-64 (IIP-64; Horowitz et al., 2003), which is a shorter form of the original IIP used to assess the difficulties that participants encounter in their interpersonal relations. The inventory consists of 64-items, which describe the potential problems encountered by respondents

with their relations with others. The items were rated on a 4-point scale and together the 64 items assess eight different factors: Domineering/Controlling, Vindictive/Self-Centered, Cold/Distant, Socially Inhibited, Non-Assertive, Overly Accommodating, Self-Sacrificing, and Intrusive/Needy. For each of the eight factors, a score was computed by averaging the participants' responses to the items relevant for the target factor. A total average score was also computed by averaging the participants' responses to the 64-items. Higher scores corresponded to more interpersonal problems.

The IIP-64 has been normed on a large sample (N=800), the internal consistency has been found to be high with coefficients ranging from .76 to .96 and test-retest reliability found to range from 0.68 to 0.93 an average interval of 7 days (Horowitz, et al. 2003; Akyunus & Gencoz, 2016). With respect to the validity of the IIP-64, convergent validity was examined by correlating the IIP-64 standard scale scores with the scores on the Beck Depression Inventory and the Beck Anxiety Inventory. The IIP-64 did not significantly differ with these two measures of self-reported depression and anxiety, correlations ranged from .31 to .48 (Horowitz, et al. 2003). As it might be expected, interpersonal difficulties may be related to but not highly predictive of the psychological symptoms of anxiety and depression. It would be expected that participants from the experimental group would have higher levels of depression, anxiety, interpersonal problems, and substance dependency than the Control group.

Finally, participants completed the Difficulties in Emotion Regulation Scale (DERS). The DERS provides a multidimensional assessment of emotion regulation and dysregulation. It is a brief, 36-item, self-report measure that assesses multiple aspects of emotion dysregulation. The measure yields a total score as well as scores on six scales

that have been derived from factor analysis: Nonacceptance, Goals, Impulse, Awareness, Strategies, and Clarity. The measure has a high internal consistency of 0.93 (Cronbach's alpha), a high test-retest reliability of 0.89, and has high content and construct validity (Gratz & Roemer, 2004).

2.3 Apparatus

Eye movements were recorded with the Eyelink 1000 system. This apparatus is a highly accurate system (<0.5º) and has an extremely high sampling rate (1000 Hz). The apparatus has one camera as well as an infrared sensor. The system was placed 75 centimeters in front of the participant at the bottom of the monitor while participants' head movements were controlled with a chinrest. One pupil was tracked in the current study and eye selection was defaulted to the participants' right pupil. A nine-point calibration procedure was used and a maximum deviation of one degree in visual angle between both calibrations was deemed satisfactory. Participants were exposed to the stimuli on a 27'' ASUS 3-D monitor after calibration had been established, and simultaneously the experimenter's monitor displayed the participant's gaze position. The gaze position was displayed by a one degree in diameter gaze cursor that allowed for examination of the system's accuracy.

2.4 Procedure

After a nine-point calibration was met with the EyeLink 1000 system, participants were exposed to the stimuli on a computer screen in front of them. The gaze position of the pupil being tracked was displayed at the same time on the experimenters monitor to allow for examination of the participants gaze position. The participants were exposed to 96 randomly presented images of smile expressions. Forty-eight of the pictures were

characteristic of enjoyment (4 encoders x 12 repetitions) and forty-eight pictures were characteristic of masking smiles (6 types of smiles x 4 encoders x 2 repetitions). All the pictures were presented in the center of a computer screen and participants were instructed to click the mouse when they were ready to provide their answer. A blank screen was present while participants verbally provide their answer as to if the image reflects enjoyment (i.e., "really happy") or not (i.e., "not really happy"). Following a "really happy" response the next image appeared. In the case of a response of "not really happy", participants were asked if they felt that the smile expression was masking another emotion. If the participant replied that another emotion was present, they were then instructed to choose the emotion they believed was present from a list of emotions presented on the screen. Participants were able to choose between: anger, fear, sadness, disgust, surprise, interest, guilt, shame, contempt, or other. The additional options were available to prevent force-choice. After providing their answer, the next image appeared on the screen.

Following the completion of the 96 trials, all participants completed the SSI-RA, BDI-II, BAI, DERS, and IIP-64. After completing the forms, participants were debriefed as to the objectives and goals of the task.

Chapter 3: Results

3.1 Data Analyses

Independent t-tests were computed to observe differences in scores between the Control group and the SUDs group on the SSI-SA, BDI-II, BAI, DERS, and the IIP-64. Additional t-tests were computed between the two groups to observe difference amongst the six subscales of the DERS and the eight subscales of the IIP-64.

Mixed-design analyses of variance (ANOVA) were computed with the smile prototype (enjoyment smile, disgust smile, angry eyes smile, angry mouth smile, sad eyes smile, sad mouth smile, and fear smile) as a within-subject factor and the group (control and SUD's) as a between-subject factor. In all analyses, an alpha level of 0.05 was used, unless otherwise indicated. An analysis was conducted to compare the probability of answering "really happy" across the seven prototypes. An analysis was also conducted on the probability of producing the expected responses. It was expected that participants would respond "really happy" for the enjoyment smile and "not really happy" for the masking smiles. When participants responded not really happy to a smile expression, they were asked if another emotion was being masked by the smile expression. An analysis was conducted to compare the probabilities of responding that another emotion was present within the smile expression. Other analyses were computed to observe participants accuracy at identifying the masked negative emotions within the smile expression.

Eye movements were scored with the EyeLink Dataviewer. This program entails that participant's fixations are viewed superimposed on the presented stimuli. Therefore, the total viewing time was measured for each of the smile types. In addition, the proportion of time gazing at the eyes, nose, and mouth areas were computed for each smile type by dividing the amount of time spent in a particular zone by the total time spent on the stimulus. At least one fixation had to occur in the interest area for an observation to be computed, if not, an empty cell was recorded (see Perron and Roy-Charland 2013). Finally, Bivariate correlations were computed to observe possible relationships between smile judgment and eye movement measures, smile judgment and

total and subscale scores on the Inventory of Interpersonal Problems, and smile judgment and total and subscale scores on the Difficulty in Emotion Regulation Scale.

3.2 Group Differences on Questionnaires

3.21 Substance Use A paired t-test was used to determine if there was a difference in total scores on the Simple Screening Instrument for Substance Abuse between the SUDs group (M = 12.65, SD = 1.23) and control group (M = .60, SD = 1.14). Results revealed a significant difference, t (38) = 32.16, $p < .01$.

3.22 Anxiety and Depression A paired t-test was used to determine if there was a difference in total scores on the Beck's Anxiety Inventory between the SUDs group (M = 23.90, SD = 16.1) and control group (M = 5.15, SD = 5.40). Results revealed a significant difference, t (38) = 4.94, $p < .001$. Another paired t-test was used to determine if there was a difference in total scores on the Beck's Depression Inventory between the SUDs group (M = 16.20, SD = 14.02) and control group (M = 6.20, SD = 5.82). Results revealed a significant difference, t (38) = 2.95, $p < .01$.

3.23 Emotion Dysregulation A paired t-test was used to determine if there was a difference in total scores on the Difficulties in Emotion Regulation Scale between the SUDs group (M = 90.30, SD = 26.5) and control group (M = 67.90, SD = 11.4). Results revealed a significant difference, t (38) = 32.16, $p < .01$. Paired t-test's were used to determine if there was a difference in scores on the six scales that make up the Difficulties in Emotion Regulation Scale: Nonacceptance, Goals, Impulse, Awareness, Strategies, and Clarity. Significant differences between the SUDs group and control group were observed on the Nonacceptance scale, t (38) = 2.54, $p < .05$, the Goals scale, t (38) = 2.76, $p < .01$, the Impulse scale, t (38) = 3.25, $p < .01$, the Strategies scale, t (38)

= 3.28, $p < .01$, and the Clarity scale, $t(38) = 32.16$, $p < .01$.

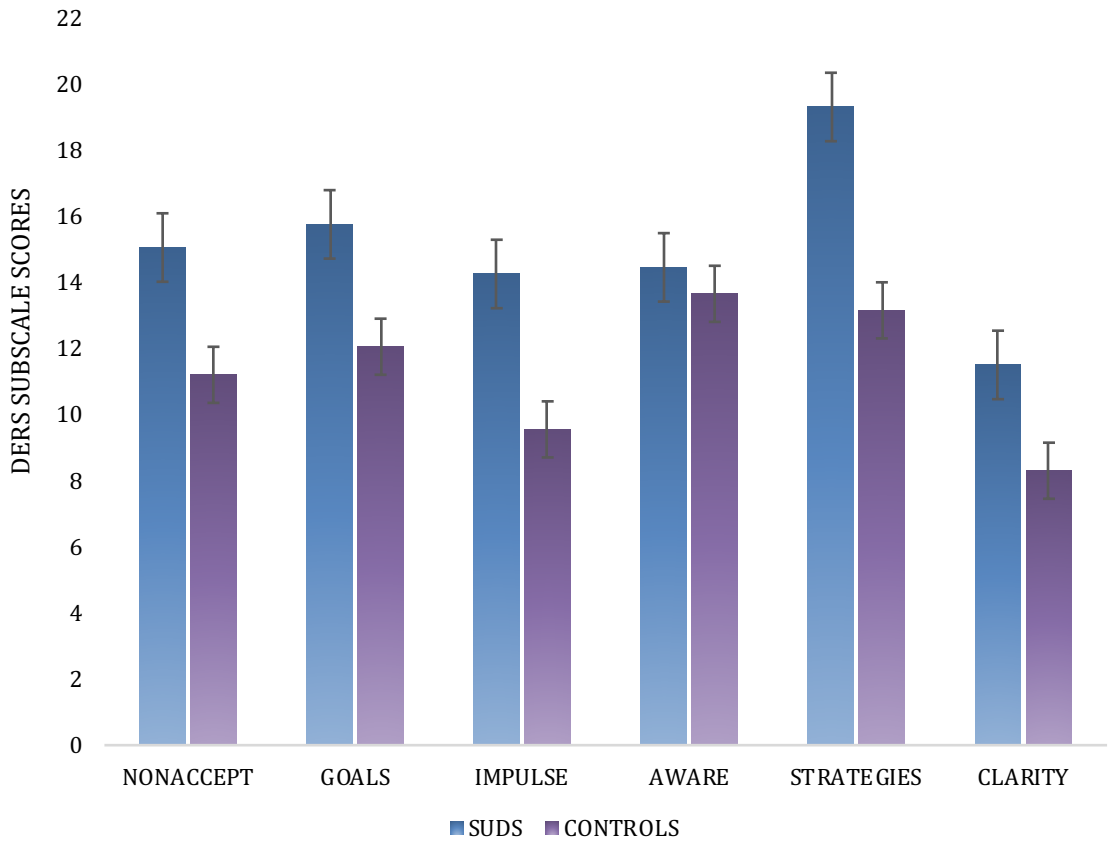

Figure 2. Mean DERS subscale scores as a function of group type (SUDs vs. Controls). Higher scores indicate greater difficulties with emotion regulation.

3.24 Interpersonal Problems A paired t-test was used to determine if there was a difference between the SUDs group (M = 104.40, SD = 35.48) and control group (M = 78.25, SD = 36.72) on total scores on the Inventory of Interpersonal Problems-64. Results revealed a significant difference, t (38) = 2.29, $p < .05$. Additional paired t-test's were computed to determine if there was a difference in scores on the eight scales that make up the Inventory of Interpersonal Problems-64: Domineering/Controlling, Vindictive/Self-Centered, Cold/Distant, Socially Inhibited, Non-Assertive, Overly Accommodating, Self-Sacrificing, and Intrusive/Needy. Significant differences between the SUDs group and control group were observed on the Domineering/Controlling scale, t (38) = 2.80, $p < .05$, the Vindictive/Self-Centered scale, t (38) = 2.69, $p < .05$, the Cold/Distant scale, t (38) = 2.60, $p < .05$, and the Intrusive/Needy scale, t (38) = 2.24 $p < .05$.

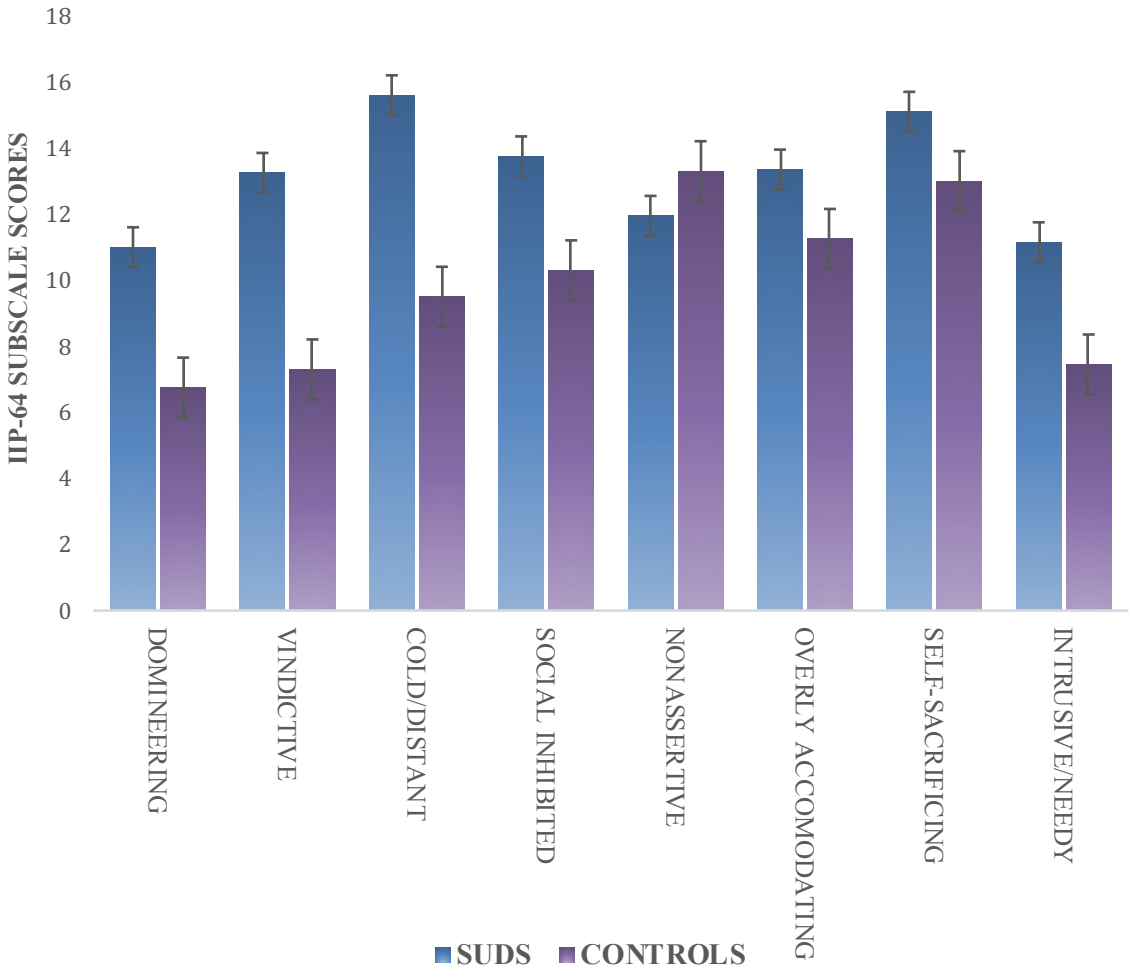

Figure 3. Mean IIP-64 subscale scores as a function of group type (SUDs vs. Controls). Higher scores indicate greater interpersonal difficulties.

3.3 Smile Judgment

3.31 Responding "really happy" A 2 x 7 mixed-design ANOVA revealed a significant main effect of smile type, $F(6,228) = 56.24$, $p < .001$, $\eta^2 p = .60$.

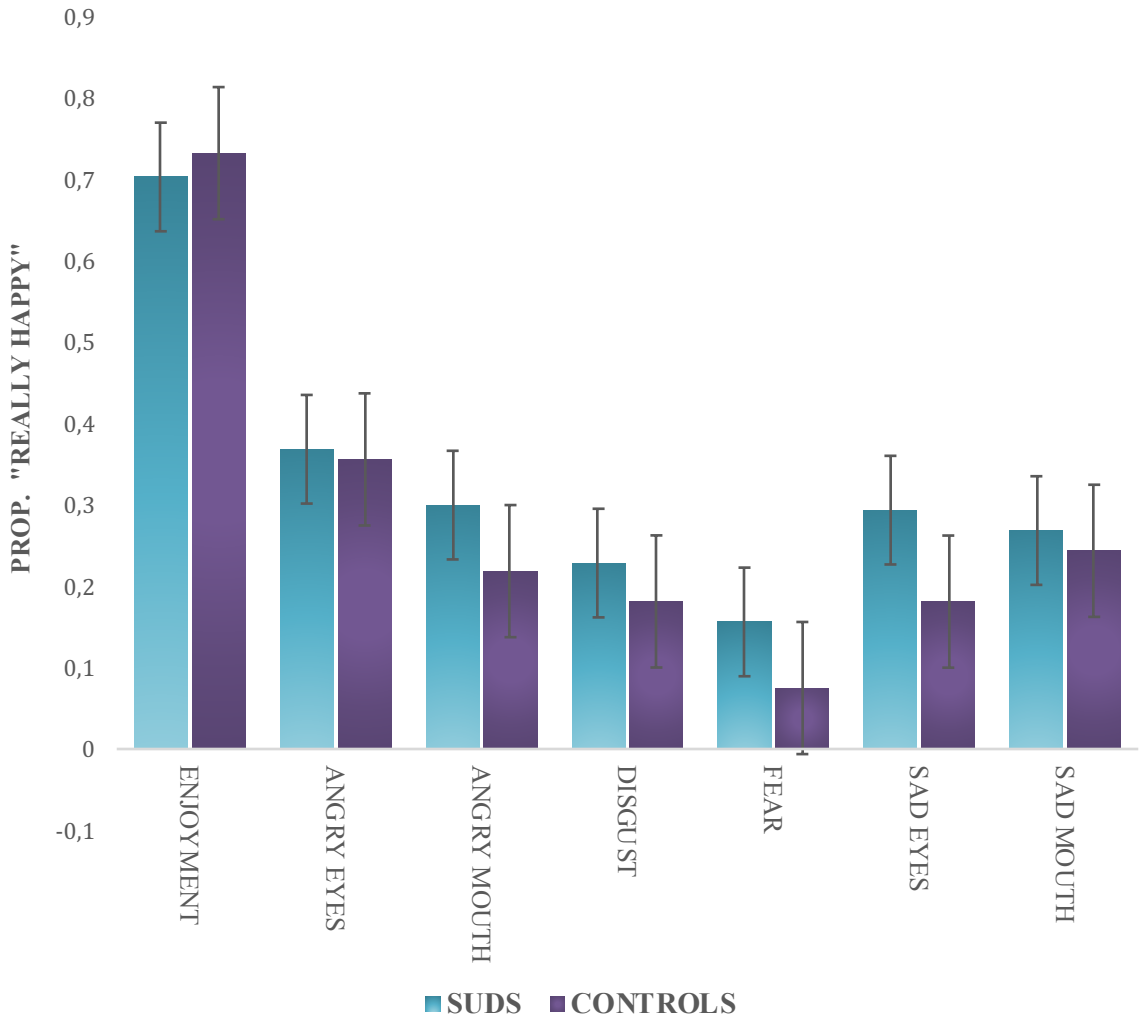

Figure 4. Probability of "really happy" response as a function of group and smile types (Enjoyment vs. Masking).

No significant main effect was revealed for group, $F(1, 38) = 1.30$, $p = .26$, $\eta^2p = .03$, nor was there a significant interaction, $F(6,228) = .868$, $p = .519$, $\eta^2p = 0.02$. Post-hoc tests (LSD) revealed that participants responded "really happy" significantly more often for the enjoyment smile expression than for any of the six masking smile expressions. The fear smile was responded to as "really happy" significantly less than any of the other smile expressions. Participants responded "really happy" significantly more often for the angry eyes masking smile than for any of the other five masking smile expressions (angry mouth, disgust, fear, sad eyes, and sad mouth). No significant differences were observed between the angry mouth, disgust, sad eye, and sad mouth smile expressions.

3.32 Expected Responses A 2 x 7 mixed-design ANOVA revealed a significant main effect of smile type, $F(6,228) = 6.46$, $p < 0.001$, $\eta^2p = .145$.

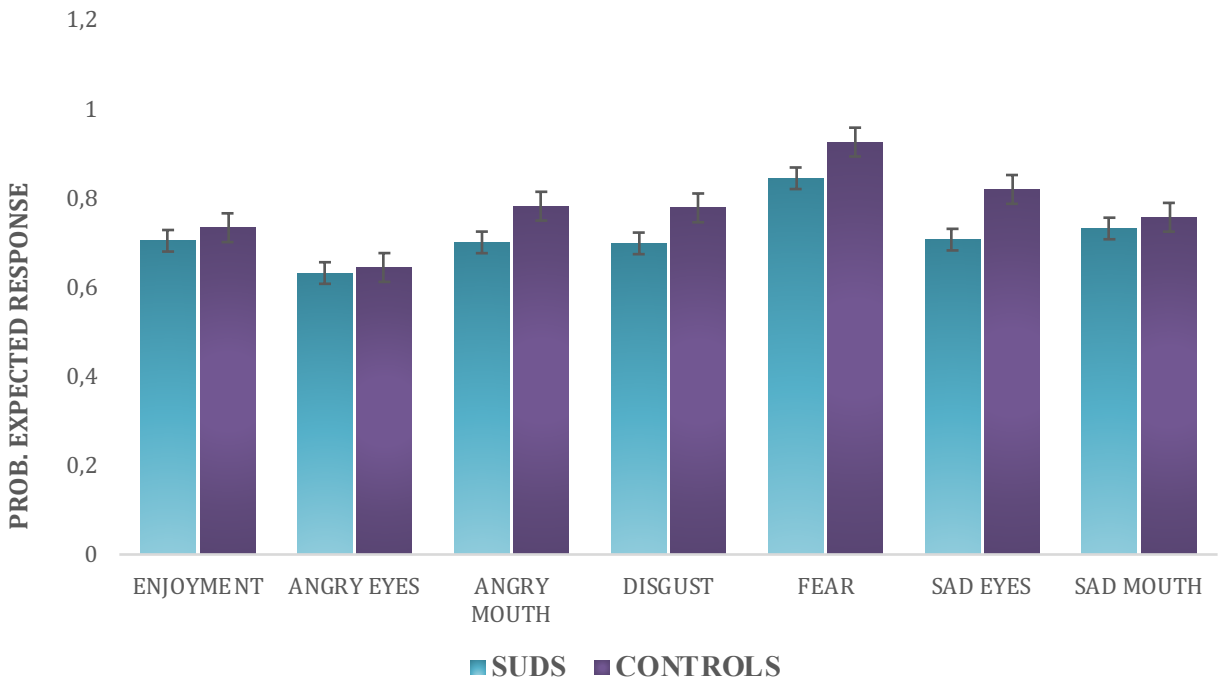

Figure 5. Probability of producing the expected response as a function of group type and smile types (Enjoyment and Masking Smiles).

No significant main effect was revealed for group, $F(1, 38) = 2.993$, $p = .092$, $\eta^2p = 0.07$, nor was there a significant interaction, $F(6,228) = .426$, $p = .861$, $\eta^2p = 0.01$. Post-hoc tests (LSD) revealed that participants produced the expected response significantly more often for the fear smile expressions than any of the other smile expressions (enjoyment, angry eyes, angry mouth, disgust, sad eyes, and sad mouth). Participants produced the expected responses least in their judgment of the angry eyes smile expressions than any of the other smile expressions (enjoyment, angry mouth, disgust, fear, sad eyes, and sad mouth). There were no significant differences observed between the enjoyment, angry mouth, disgust, sad eyes, and sad mouth smile expressions.

3.33 Presence of Another Emotion A 2 x 7 mixed-design ANOVA revealed a significant main effect for group type $F(1,38) = 8.115$, $p < .01$, $\eta^2p = .176$.

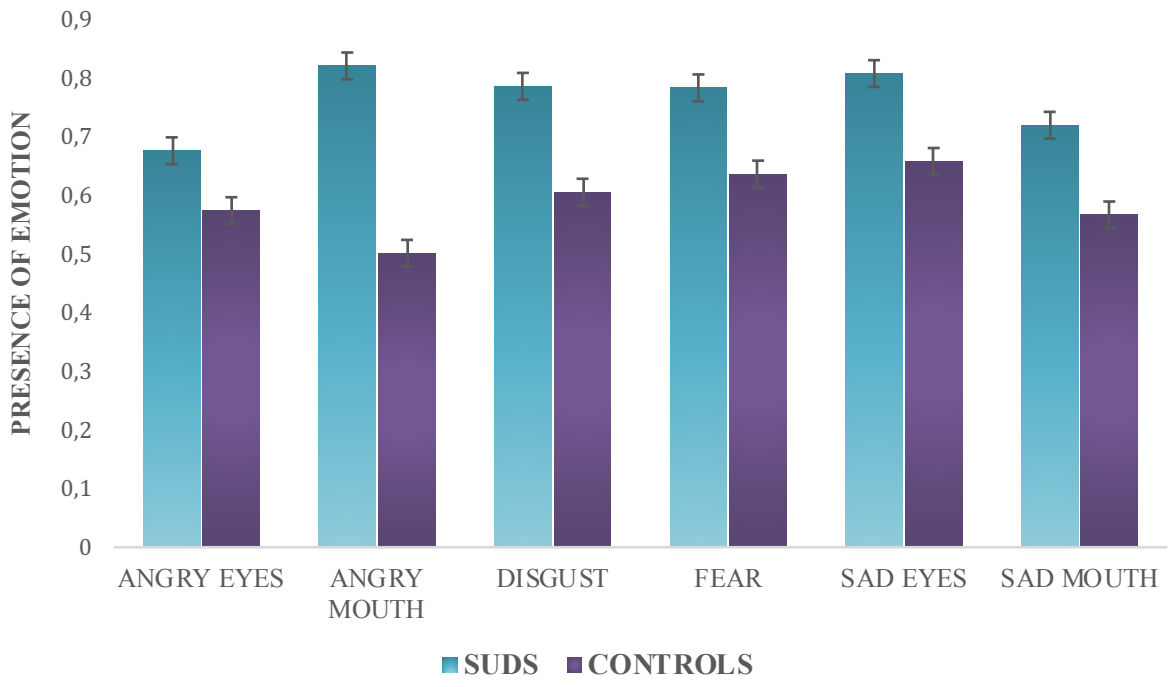

Figure 6. Probability of responding that another emotion was present as a function of group type (SUDs vs. Control) and masking smile types.

No significant main effect was revealed for smile type, $F(5, 190) = 1.711$, $p = .134$, $\eta^2p = .04$, nor was there a significant interaction, $F(5,190) = 1.393$, $p = .229$, $\eta^2p = .04$. The results revealed that participants from the SUDs group were significantly more likely than the control group to report the presence of another emotion in the judgment of the masking smile expressions

3.34 Identifying Masked Emotion A 2 x 6 mixed-design ANOVA revealed a significant main effect for group type $F(1,38) = 8.115$, $p < 0.05$, $\eta^2p = .125$.

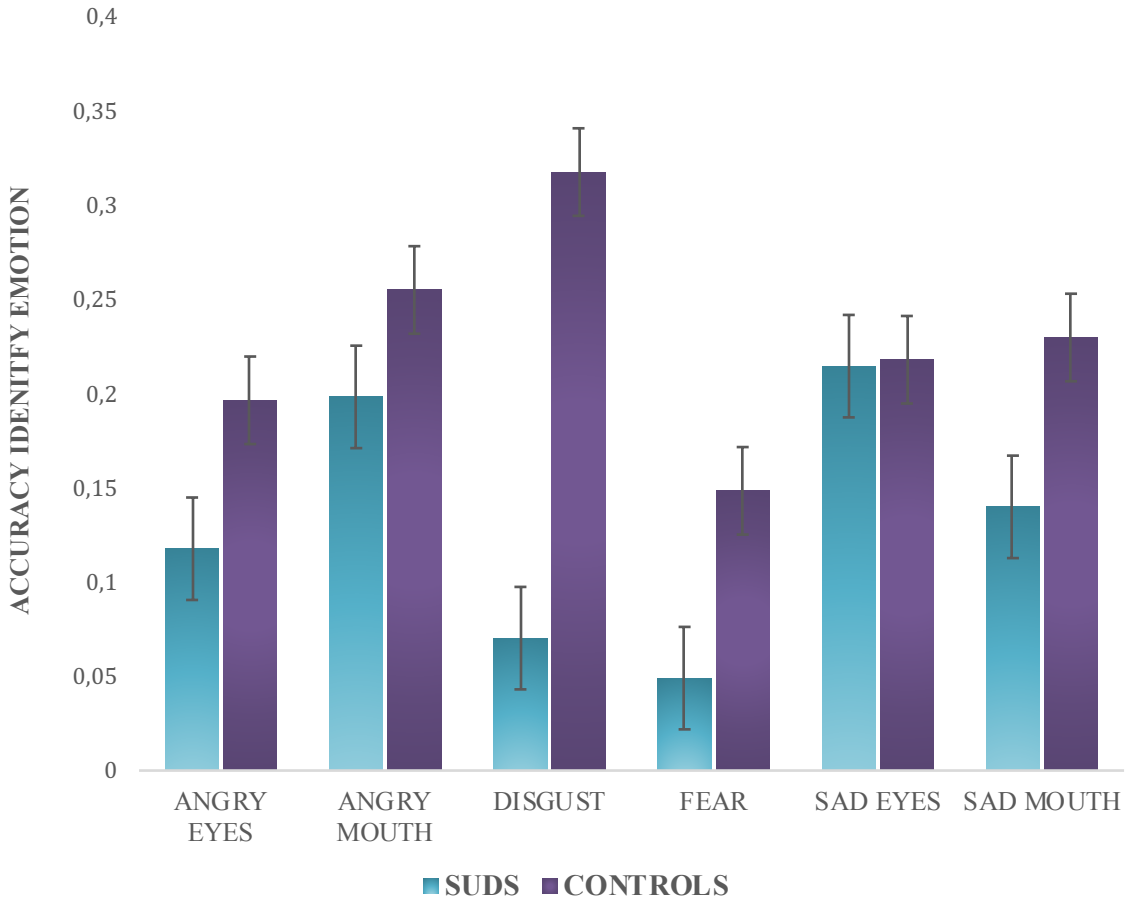

Figure 7. Mean accuracy at identifying the masked emotion as a function of group type (SUDs vs. Control) and masking smile types.

No significant main effect was revealed for smile type, $F(5,165) = 1.577$, $p = .169$, $\eta^2p = .05$, nor was there a significant interaction, $F(5,165) = 1.214$, $p = .305$, $\eta^2p = .04$. Results revealed that participants from the control group were more accurate than the SUDs group at identifying the negative emotion masked by the smile expression. Order of accuracy for the control group was disgust, angry mouth, sad mouth, sad eyes, angry eyes, and fear. Order of accuracy for the SUDs group was sad eyes, angry mouth, sad mouth, angry eyes, disgust, and fear.

3.4 Eye-Movement Measures

3.41 Total viewing time A 2 x 6 mixed-design ANOVA revealed a significant main effect for smile type $F(6,228) = 2.183$, $p < .05$, $\eta^2p = .054$, and a significant main effect for group type $F(1,38) = 8.115$, $p < .001$, $\eta^2p = .108$.

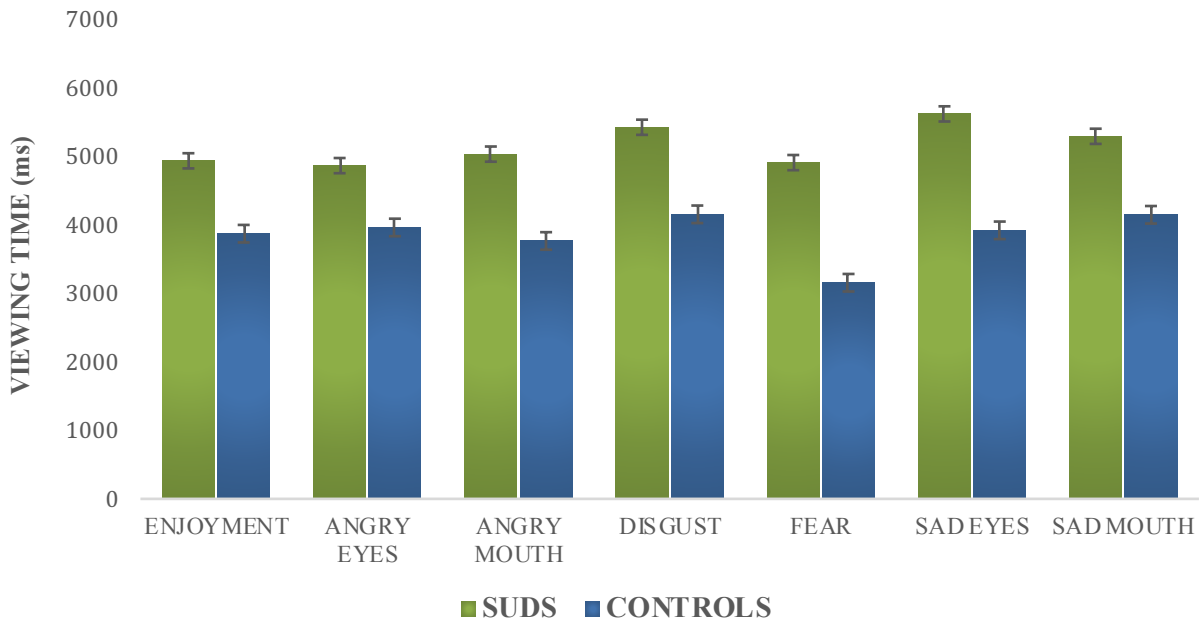

Figure 8. Mean viewing time as a function of group type (SUDS vs. Controls) and smile types (Enjoyment and Masking Smiles)

No significant interaction was observed $F(6,228) = .731$, $p = .625$, $\eta^2p = .019$. Results revealed that participants from the SUDs group spent significantly more time than the control group viewing the smile expressions in the judgment task. Post-hoc tests (LSD) revealed that all participants spent significantly more time viewing the disgust, sad eyes, and sad mouth smile expressions than the fear smile expression. No significant differences in total viewing time were observed between the angry eyes, angry mouth, and enjoyment smile expressions.

3.42 Interest areas A 2 x 3 x 7 mixed-design ANOVA revealed a significant interaction between interest area and smile type $F(12,456) = 6.98$, $p < .001$, $\eta^2p = .16$. A main effect of interest area (eyes, mouth, nose) also reached significance $F(2,456) = 8.78$, $p < .001$, $\eta^2p = .19$.

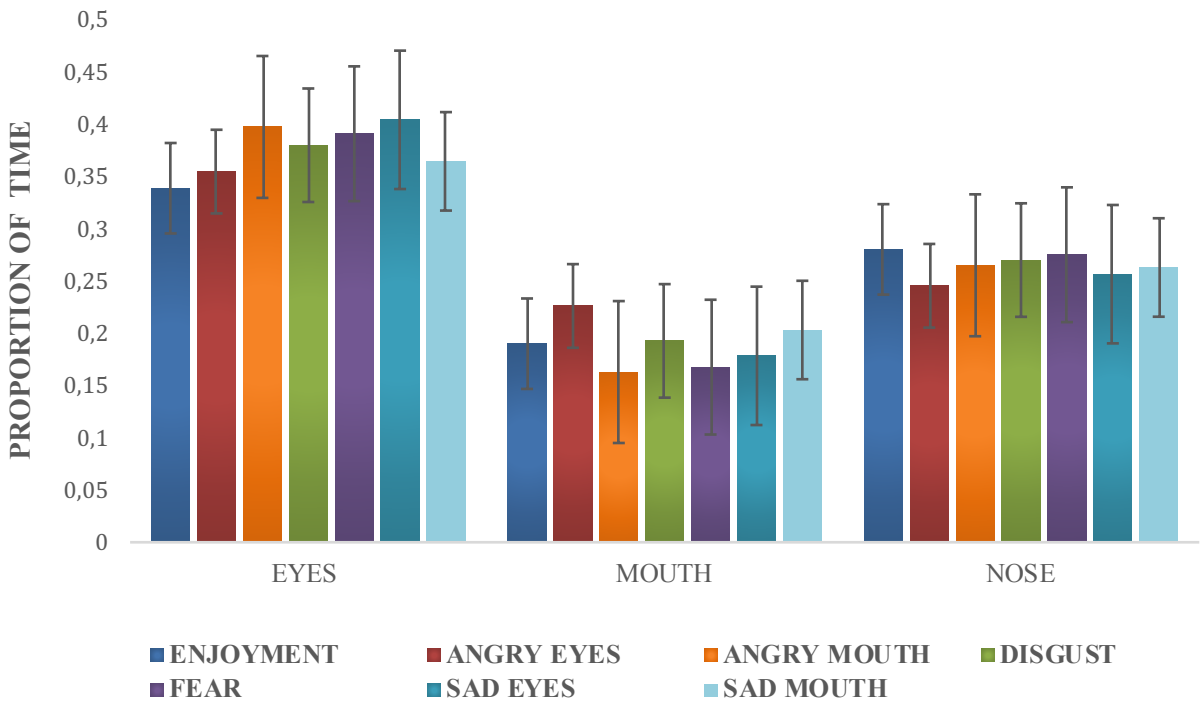

Figure 9. Proportion of viewing time as a function of interest area (eyes, nose, mouth) and smile types (Enjoyment and Masking Smiles).

No significant main effect of smile type, $F(6,228) = 2.031$, $p = .085$, $\eta^2p = .05$ or group type was observed, $F(1,38) = .330$, $p = .57$, $\eta^2p = .009$. Simple main effects tests were computed to explore the interaction between smile type and interest areas. Dunn's correction was applied to alpha and to be considered significant p value needed to be smaller than .015. A difference between interest areas were observed for Angry Mouth, $F(2, 78) = 13.38$, $p < .001$, $\eta^2p = .26$, Disgust, $F(2, 78) = 7.79$, $p < .01$, $\eta^2p = .17$, Enjoyment, $F(2, 78) = 5.97$, $p < .01$, $\eta^2p = .13$, Fear, $F(2, 78) = 11.1$, $p < .001$, $\eta^2p = .22$, Sad Eyes, $F(2, 78) = 5.99$, $p < .001$, $\eta^2p = .24$, and Sad Mouth, $F(2, 78) = 12.07$, $p < .01$, $\eta^2p = .13$. Post-hoc tests (LSD) revealed that participants viewed the eyes more than the mouth and nose, and the eyes and mouth more than nose for Angry Mouth and Disgust smile types. Participants viewed the eyes more than mouth, the mouth less than the eyes and nose, and the nose more than mouth for the Enjoyment and Fear smile type. Participants viewed the eyes more than the mouth and nose, and the eyes and mouth more than nose for the Sad Eyes smile type. Finally, the eyes were viewed significantly more than the mouth in Sad Mouth smile types. No significant differences of interest areas was observed for Angry Eyes $F(2, 78) = 4.56$ $p = .23$, $\eta^2p = .10$.

3.5 Correlations

3.51 Eye-Movements and Expected Responses A series of correlations were computed between the proportion of expected responses and the proportion of time in the eyes, nose and mouth areas considering all available data for all participants as a function of the smile type and of the group. For Angry Eyes, a significant negative correlation was observed between the proportion of time spent in the mouth and the expected responses for the SUDs group, $r = -.46$, $p = .02$, and between the proportion of time spent in the

nose and the expected responses for the control group, $r = -.50$, $p = .03$. For Sad Eyes, a significant positive correlation was observed between the proportion of time spent in the eyes and the expected responses for the control group, $r = .47$, $p = .03$. For the Enjoyment smile, a significant positive correlation was observed between the proportion of time spent in the mouth and the expected responses for the control group, $r = .54$, $p = .01$. None of the other correlations were significant.

3.52 Eye-Movements and Presence of Another Emotion A series of correlations were computed between the mean probabilities of responding that another emotion was present and the proportion of time in the eyes, nose, and mouth areas considering all available data for all participants as a function of the smile type and of the group. For Angry Eyes, a significant negative correlation was observed between the proportion of time spent in the mouth and the mean probabilities of responding that another emotion was present for the SUDs group, $r = -.48$, $p = .03$. For Angry Mouth, a significant positive correlation was observed between the proportion of time spent in the mouth and the mean probabilities of responding that another emotion was present for the control group, $r = .50$, $p = .03$. For Fear, a significant positive correlation was observed between the proportion of time spent in the eyes and the mean probabilities of responding that another emotion was present for the SUDs group, $r = .50$, $p = .02$. None of the other correlations were significant.

3.53 Eye-Movements and Identifying Masked Emotion A series of correlations were computed between the proportion of accurate responses in naming the masked emotion and the proportion of time in the eyes, nose, and mouth considering all available data for all participants as a function of the smile type and of the group. For Angry

Mouth, a significant positive correlation was observed between the proportion of time spent in the nose and proportion of accurate responses in naming the masked emotion for the control group, $r = .48$, $p = .03$. For Sad Mouth, a significant positive correlation was observed between the proportion of time spent in the nose and proportion of accurate responses in naming the masked emotion for the control group, $r = .63$, $p = .004$. None of the other correlations were significant.

3.54 Anxiety/Depression and Smile Judgment A series of correlations were computed between the total scores on the Beck's Anxiety Inventory and the proportion of expected responses, the mean probabilities of responding that another emotion was present, and the proportion of accurate responses in naming the masked emotion as a function of smile type and group type. For Fear, a significant positive correlation was observed between the total scores on the Beck's Anxiety Inventory and the mean probabilities of responding that another emotion was present for the control group, $r = .57$, $p = .009$. For Fear, a significant positive correlation was observed between the total scores on the Beck's Anxiety Inventory and the proportion of accurate responses in naming the masked emotion for the control group, $r = .56$, $p = .01$. None of the other correlations were significant.

Another series of correlations were computed between the total scores on the Beck's Depression Inventory and the proportion of expected responses, the mean probabilities of responding that another emotion was present, and the proportion of accurate responses in naming the masked emotion as a function of smile type and group type. For Sad Eyes, a significant negative correlation was observed between the total scores on the Beck's Depression Inventory and the mean probabilities of responding that

another emotion was present for the SUDs group, $r = -.46$, $p = .03$. For Sad Mouth, a significant positive correlation was observed between the total scores on the Beck's Depression Inventory and the mean probabilities of responding that another emotion was present for the control group, $r = .47$, $p = .04$. None of the other correlations were significant.

3.55 Emotion Regulation and Smile Judgment A series of correlations were computed between the total and subscale scores on the Difficulties in Emotion Regulation Scale and the proportion of expected responses, the mean probabilities of responding that another emotion was present, and the proportion of accurate responses in naming the masked emotion as a function of smile type and group type.

Total Scores For Angry Eye, a significant negative correlation was observed between the total scores on the Difficulties in Emotion Regulation Scale and the proportion of expected responses for the SUDs group, $r = -.45$, $p = .01$. For Angry Mouth, a significant negative correlation was observed between the total scores on the Difficulties in Emotion Regulation Scale and the mean probabilities of responding that another emotion was present for the control group, $r = -.60$, $p = .005$. For Sad Eyes, a significant negative correlation was observed between the total scores on the Difficulties in Emotion Regulation Scale and the mean probabilities of responding that another emotion was present for the control group, $r = -.49$, $p = .03$. None of the other correlations with total scores were significant.

Subscale Scores For Angry Eyes, a significant negative correlation was observed between the Impulsive scale and the proportion of expected responses for the SUDs group, $r = -.49$, $p = .03$. For Angry Eyes, a significant negative correlation was

observed between the Strategies scale and the proportion of expected responses for the SUDs group, $r = -.59$, $p = .01$. For Angry Mouth, a significant negative correlation was observed between the Clarity scale and the proportion of expected responses for the control group, $r = -.48$, $p = .03$. For Sad Eyes, a significant negative correlation was observed between the Strategies scale and the mean probabilities of responding that another emotion was present SUDs group $r = -.45$, $p = .04$. For Sad Eyes, a significant negative correlation was observed between the Goals scale and the mean probabilities of responding that another emotion was present for the SUDs group, $r = -.54$, $p = .02$. Angry mouth a significant negative correlation was observed between the Strategies scale and the mean probabilities of responding that another emotion was present for the control group, $r = -.55$, $p = .01$, the Impulse scale and the mean probabilities of responding that another emotion was present for the control group, $r = -.57$, $p = .01$, and the Nonacceptance scale and the mean probabilities of responding that another emotion was present for the control group, $r = -.55$, $p = .01$. For Disgust, a significant negative correlation was observed between the Goals scale and the proportion of accurate responses in naming the masked emotion for the SUDs group, $r = -.47$, $p = .04$. For Sad Eyes, a significant negative correlation was observed between the Nonacceptance scale and the proportion of accurate responses in naming the masked emotion for the control group, $r = -.45$, $p = .04$. None of the other correlations with subscale scores were significant.

3.56 Interpersonal Problems and Smile Judgment A series of correlations were computed between the total and subscale scores on the Inventory of Interpersonal Problems-64 and the proportion of expected responses, the mean probabilities of

responding that another emotion was present, and the proportion of accurate responses in naming the masked emotion as a function of smile type and group type.

Total Scores For the SUDs group, a significant positive correlation was observed between Disgust and the mean probabilities of responding that another emotion was present, $r = .51$, $p = .02$, and between Sad Mouth and the mean probabilities of responding that another emotion was present, $r = .47$, $p = .04$. For the control group, a significant negative correlation was observed between Disgust and the mean probabilities of responding that another emotion was present, $r = -.54$, $p = .01$. None of the other correlations with total scores were significant.

Subscale Scores For the SUDs group, a significant positive correlation was observed between the Cold/Distant scale and the proportion of expected responses for Sad Eyes, $r = .48$, $p = .03$. For the SUDs group, a significant negative correlation was observed between Vindictive/Self-Centered scale and the proportion of expected responses for Angry Eyes, $r = -.46$, $p = .04$ and a significant negative correlation was observed between Vindictive/Self-Centered scale and the proportion of expected responses for Disgust, $r = -.56$, $p = .01$. For the SUDs, a significant negative correlation was observed between Overly Accommodating scale and the proportion of expected responses for Angry Eyes, $r = -.51$, $p = .02$. For the control group, a significant positive correlation was observed between the Intrusive scale and the proportion of expected responses for Sad Eyes, $r = .51$, $p = .02$, and a significant negative correlation was observed between Overly Accommodating scale and the proportion of expected responses for Angry Eyes, $r = -.59$, $p = .006$.

For the SUDs group, a significant positive correlation was observed between the

Vindictive/Self-Centered scale and the mean probabilities of responding that another emotion was present for Angry Eyes, $r = .49$, $p = .03$, a significant positive correlation was observed between the Cold/Distant scale and the mean probabilities of responding that another emotion was present for Angry Eyes, $r = .49$, $p = .03$, a significant positive correlation was observed between the Socially Inhibited scale and the mean probabilities of responding that another emotion was present for Disgust, $r = .45$, $p = .05$, significant positive correlation was observed between the Overly Accommodating scale and the mean probabilities of responding that another emotion was present for Disgust, $r = .46$, $p = .04$, a significant positive correlation was observed between the Overly Accommodating scale and the mean probabilities of responding that another emotion was present for Fear, $r = .52$, $p = .02$, and a significant positive correlation was observed between the Overly Accommodating scale and the mean probabilities of responding that another emotion was present for Sad Mouth , $r = .56$, $p = .01$. For the control group, a significant negative correlation was observed between the Vindictive/Self-Centered scale and the mean probabilities of responding that another emotion was present for Angry Mouth $r = -.55$, $p = .01$, a significant negative correlation was observed between the Vindictive/Self-Centered scale and the mean probabilities of responding that another emotion was present for Disgust, $r = -.51$, $p = .02$, a significant negative correlation was observed between the Vindictive/Self-Centered scale and the mean probabilities of responding that another emotion was present for Sad Mouth, $r = -.48$, $p = .03$, a significant negative correlation was observed between the Self Sacrificing scale and the mean probabilities of responding that another emotion was present for Disgust, $r = -.46$, $p = .04$, and a significant negative correlation was observed between the Intrusive/Needy

scale and the mean probabilities of responding that another emotion was present for Disgust, $r = -.51$, $p = .02$. For the SUDs group, a significant negative correlation was observed between the Domineering/Controlling scale and the proportion of accurate responses in naming the masked emotion for Angry Mouth, $r = -.73$, $p = .000$. None of the other correlations among subscale scores were significant.

Chapter 4: Discussion

Research indicates that individuals with SUDs experience difficulties with their interpretation and judgment of emotional facial expressions (Philippot, et al. 1999; Kornreich et al., 2002, 2003; Townshend & Duka, 2003; Fernandez-Serrano, et al., 2010; Foisy, et al. 2007; D'Hondt, de Timary, Bruneau, & Maurage, 2015). In addition to being less accurate in their judgments of emotional facial expressions, they have been found to overestimate the intensity of emotion in facial expressions, require a greater intensity of cues to perceive the emotion, and have biases towards perceiving expressions as being negative (Frigerio et al., 2002; Kornreich et al., 2001; Philippot et al., 1999; Townshend & Duka, 2003). However, no research has examined their judgments made regarding the authenticity of smile expressions that contain characteristics of enjoyment and masking smile expressions that contain characteristics of both enjoyment and traces of negative emotions. Additionally, no research has examined the attentional processes individuals with SUDs employ while making judgments of emotional facial expressions. Past literature indicates that the ability to accurately recognize emotional facial expressions is a necessary skill required prior to gaining the ability to effectively regulate emotional states (Izard, 2001; Lane, et al., 2001) and for effective interpersonal functioning (Marsh, Ambady, Kozak, 2007; Wang, 2009). While research has explored the relationship

between macroexpression recognition and interpersonal functioning in SUDs, to the best of our knowledge, no study has explored the relationship between the judgments of masking smile expressions (i.e., microexpressions) that contain traces of negative emotions, interpersonal functioning and emotion dysregulation in SUDs.

The current study aimed to investigate differences that occur between individuals with SUDs and controls in their ability to judge enjoyment smiles and masking smile expressions that contained traces of anger, disgust, sadness, or fear. Their ability to accurately identify the masked negative emotions in the smile expressions was also explored, and to the best of our knowledge, the current study was the first to employ eye-tracking to observe the attentional processes individuals with SUDs employ in the judgment of emotional facial expressions. The current study also aimed to explore the relationships between smile judgment and both emotion dysregulation and interpersonal functioning as they relate to those with SUDs when compared to healthy controls.

4.1 Smile Judgment: Authenticity of Smiles

While previous research indicates that individuals with SUDs have difficulties in their interpretation of emotional facial expressions (Philippot, et al. 1999; Kornreich et al., 2002, 2003; Townshend & Duka, 2003; Fernandez-Serrano, et al., 2010; Foisy, et al. 2007; D'Hondt, de Timary, Bruneau, & Maurage, 2015), the results from the current study suggests that they are no different than healthy controls in their categorization of enjoyment and masking smile expressions as "really happy" or "not really happy". However, "really happy" responses varied as a function of the smile prototype. For instance, participants responded "really happy" more often for the enjoyment smiles and least often for the fear masking smiles. Interestingly, the results also revealed no

significant difference between those with SUDs and controls in the probability of producing the expected response of “really happy” for the enjoyment smiles or “not really happy” for the masking smiles. These results would suggest that individuals with SUDs and healthy controls make similar judgments regarding the authenticity of enjoyment smiles and masking smiles. However, again, the probability of producing the expected response varied as a function of the smile types. Specifically, participants produced the expected response most often for the fear masking smile expression, and least often for the angry eyes masking smile expression.

As it pertains to those with SUDs, it could be that their previously observed biases for interpreting facial expressions as hostile or negative (Frigerio et al., 2002; Kornreich et al., 2001; Philippot et al., 1999; Townshend & Duka, 2003) played a beneficial role in their judgment of the masking smiles expressions as “not really happy”. In fact, results from the current study indicated that individuals with SUDs were more likely than their healthy counterparts to report the presence of another emotion when they judged the expression as “not really happy”. These results provide further support for a negative bias in SUDs, as the results suggest that individuals with SUDs more often interpreted the expressions as masking some form of negative emotion as opposed to just interpreting the smile as simply “not really happy”. The observed bias these individuals have towards perceiving another emotion within the masking smile expressions might best be explained in terms of the Cognitive Theory of Depression, which states that individuals with depressed mood states have distorted negative perceptions (specifically, negative beliefs and schemas) about themselves, other people, and the world (Beck, 1964; Beck, Rush, Shaw, & Emery, 1979). Perhaps these negative perceptions observed in individuals with

depressed mood states further extends to judgments regarding others' emotional facial expressions, as the results of the current study did indicate that individuals with SUDs have significantly higher scores on the depression measure than the controls.

Interestingly, regardless of a SUD, judgments made in the current study replicate those from the Perron et al (2016) study whereby participants most often responded "really happy" for enjoyment smile expressions and least often for fear masking smile expressions. Similar to Perron et al (2016), participants produced the expected response most often for the fear masking smile expressions. It would seem that irrespective of a SUD, participants were most sensitive to smile expressions containing traces of fear, as seen in their tendency to respond "really happy" least often to these expressions and most often produce the expected response of "not really happy". Evolved fear module theories would suggest that individuals are sensitive to these expressions because all individuals have an evolved fear system that is preferentially activated by fear related stimuli (e.g., traces of fear within the expressions) thus allowing for the quick perception of potential danger within one's environment (Adolphs, 2013; Ohman & Mineka 2001). In other words, individuals may be more sensitive to fear related stimuli in the environment, such as smiles masking fear, because we have evolved in a way that allows for the quick perception of any danger or threat in our environment.

Similarly to Perron et al (2016), of the six masking smile expressions, participants judged the angry eyes masking smile expression most often as "really happy" and produced the expected response least often for this smile expression. Again, irrespective of a SUD, these masking smile expressions seemed to be the most difficult for participants to accurately judge and distinguish from the enjoyment expressions. These

results are opposite to those found in the recognition tasks of macroexpressions where anger is often the most accurately identified negative emotion (Beaudry et al., 2014; Calvo & Lundqvist, 2008). However, similarly to Perron et al (2016), the ability to distinguish between the enjoyment and the masking smile expressions containing traces of anger also varied as a function of the area of the face where the trace was presented. For instance, the probability of producing the expected response was greater when the trace of anger was presented in the mouth as opposed to the eyes. These results suggest that the ability to distinguish between enjoyment smiles and masking smiles that contain traces of negative emotions varies not only as a function of the masked negative emotions, but also as a function of the area of the face that the trace is presented (i.e., eyes, nose, mouth).

4.2 Smile Judgment: Identification of Masked Emotions

While the individuals with SUDs were more likely than their healthy counterparts to report the presence of another emotion, the current results suggest that they are actually less likely to be accurate in their identification of the masked negative emotion. This deficit was observed regardless of the smile type (i.e., enjoyment, angry eyes, angry mouth, sad eyes, sad mouth, disgust, and fear). Previous research indicates that individuals with SUDs experience a deficit in their ability to identify macroexpressions (full-faced expressions) of negative emotions (Kornreich et al., 2002; Kornreich et al., 2003; Fernandez-Serrano, et al., 2010; Foisy et al., 2007; Philippot et al., 1999; Townshend & Duka, 2003). In effect, the results from the current study suggest that this difficulty further extends to the judgment of smile expressions containing traces of negative emotions (i.e., masking smile expressions).

Research indicates that the ability to categorize the expressions as “really happy” or “not really happy” relies on implicit processes while the ability to identify the precise emotion relies heavily on explicit knowledge of the emotion (Perron et al., 2016; Gosselin et al., 2002). It could be that individuals with SUDs lack the explicit knowledge required for the identification of the negative emotions. Additionally, research suggests that the continued use/abuse of substances significantly impairs executive functioning and other process controlled by the pre-frontal cortex, an area of the brain that has been implicated in the ability to successfully identify emotional facial expressions (Fernandez-Serrano, Perez-Garcia, Riovalle, & Verdejo-Garcia, 2009; Fernandez-Serrano, Perez-Garcia, Perales, & Verdejo-Garcia, 2010; Hoaken, Allaby, & Earle, 2007). These impairments are thought to contribute to individuals with SUDs evidenced difficulty making correct judgments regarding negative emotional facial expressions (Fernandez-Serrano et al., 2010; Phan et al., 2002). The results of the current study suggest that the impairments individuals with SUDs experience in their judgment of emotional expressions also extends towards their judgments regarding the authenticity of smile expressions and the identification of masked negative emotions.

4.3 Perceptual-Attentional Processes: Viewing Time

Results of the current study revealed that compared to healthy controls, the participants with SUDs spent more time attending to the various smile expressions when making judgments about the expressions. These results are similar to prior research studies that have examined response times in the judgment of emotional facial expressions of individuals with SUDs and have also found that they often require more time than their healthy counterparts (Craparo et al., 2016; Foisy et al., 2005; Foisy et al.,

2007). The overall additional time required to categorize the emotional expressions may have been due to other factors, such as the slowed cognitive processing observed in mood disorders such as depression, as the results indicated that those with SUDs presented with significantly higher levels of depression than controls. Depression has long been known to be associated with decreased processing speed (Nebes, et al., 2000; Payne & Thompson, 2015). Additionally, this slowed processing speed has been shown to effect executive functioning (Payne & Smith, 2014; Payne & Thompson, 2015; Sheppard & Vernon, 2008), such as those required to make judgments regarding emotional facial expressions. Depression is also a common comorbid disorder of SUDs (Davis, Uezato, Newell, & Frazier, 2008; Swendsen, & Merikangas, 2000; Currie, 2005), and interestingly, research has shown that those with depressive disorders also have deficits in their ability to accurately interpret negative emotional expressions (Berg, et al., 2016; Demenescu, Kortekaas, Boer, & Aleman, 2010; Csukly, et al., 2010). Future research should query this hypothesis further.

In addition to a difference between group types, the length of time spent attending to the various smile expressions also differed as a function of the smile types. Specifically, the results revealed that not all smile types are attended to equally. For instance, participants spent significantly more time viewing the disgust, sad eyes, and sad mouth smile expressions than they did the fear smile expressions. No significant differences in total viewing time were observed between the angry eyes, angry mouth, and enjoyment smile expressions. The results then suggest that in addition to participants being least likely to respond “really happy” to the fear masking smile and most likely to produce the expected response of “not really happy” to the fear masking smile, this

expression is also viewed for the least amount of time by participants when making their judgments of the expression, irrespective of a SUD. The fact that all individuals required significantly less time viewing and attending to the masking smiles containing traces of fear when making judgments of the expressions further provides evidence to support an automatic evolved fear module that is preferentially activated for fear related stimuli (Adolphs, 2013; Ohman & Mineka 2001).

4.4 Perceptual-Attentional Processes: Interest Areas (Eyes, Mouth, Nose)

There were no significant differences observed between those with SUDs and controls in the interest areas most attended to while making judgments of the expressions (i.e., eyes, nose, mouth). However, the results revealed that the area of the expressions given most attention did vary as a function of the interest area (i.e., eyes, nose, mouth), regardless of whether an individual had a SUD. All participants spent more time attending the eye area than the nose and mouth areas, and spent more time attending the mouth area than the nose area. A significant interaction revealed that attention to the various areas of the expression is found to differ as a function of the various smile types. For instance, for the angry mouth and disgust masking smile expressions, participants viewed the eyes more than the mouth and nose, and the eyes and mouth more than the nose. Conversely, for the enjoyment smile and fear masking smile expression, participants were found to view the eyes more than mouth, and the nose more than the mouth.

These results suggest that similarly to Perron et al (2016), participants do not differentially attend to the regions of the face where the cues of the negative emotions are present, a strategy that may be beneficial when interpreting masking smile expressions.

For instance, when making judgments of the angry eyes masking smile expression, it might have been a beneficial strategy for participants to have viewed the mouth area of the expression more than the eye area of the expression because this is where the trace of the anger expression is located. If the ability to accurately interpret masking smile expressions relied on these perpetual-attentional processes, then increased attention to the area of the face where the trace of the negative emotion was presented should have been associated with greater accuracy in the judgment task. The results did not indicate any patterns to suggest that they differentially attended to the expressions as a function of where the trace of negative emotions were present. Therefore, while attending the area of the face where the negative emotion is present may seem like a logical and beneficial approach to the decoding of masking smile expressions, results of the current study further indicate that participants do not employ this strategy when making judgments of these expressions.

4.5 Perceptual-Attentional Processes: Correlations

Correlations between the eye-tracking data and responses from the judgment task revealed some links between attentional processes and smile judgments indicating that attentional processes may indeed play a role in the judgment of enjoyment and masking smile expressions. However, these relationships varied as a function of the group (i.e., SUDs group and Control group) and the smile type (i.e., enjoyment, angry eyes, angry mouth, sad eyes, sad mouth, fear, and disgust). For instance, the results revealed that for the control group only, a positive relationship existed between the proportion of time spent in the eyes and the expected responses for the sad eyes masking smile expression. Likewise, for the SUDs group only, a significant negative correlation was observed

between the proportion of time spent in the mouth and the mean probabilities of responding that another emotion was present for the angry eyes masking smile. Overall, the results suggest a complex relationship between attentional processes and some aspects of smile judgment (i.e., the proportion of expected responses and the mean probabilities of responding that another emotion was present) that varies according to the smile type and group type. Nevertheless, it is in the identification of the emotions whereby attentional processes have been implicated as being important.

With respect to a link between accuracy at identifying the masked negative emotions and attentional processes, no clear patterns or links observed between eye-movement data and accuracy at identifying the emotion was observed. For instance, for the angry mouth masking smile, a significant positive correlation was observed between the proportion of time spent in the nose and proportion of accurate responses in naming the masked emotion for the control group only. The results are somewhat similar to Perron et al (2016) whereby the time spent in the area comprising the trace of negative emotion did not consistently or logically correlate with the performance at the judgment task. These results further suggest that there is no strong relationship between attentional processes and performances at masking smile judgment, especially in regard to the identification of negative emotions within the smile expressions. It may be that irrespective of a SUD, no link exists at all between the identification of negative emotions in masking smiles and attentional processes employed during the task.

4.6 Emotional-Interpersonal Functioning and Smile Judgment

The results indicated that those with SUDs presented with greater levels of emotion dysregulation and interpersonal problems than those from the control group. In

fact, differences were observed between those with SUDs and healthy controls on five of the six subscales of the DERS and four of the eight subscales of the IIP-64. These results are not surprising given the extent that emotion dysregulation and interpersonal problems have been implicated in in the development and maintenance of SUDs (Kelly & Bardo, 2016; Kober, 2014; Spence, & Coubasson, 2012; Lander, et al., 2013; Unger, et al., 2003; Wilens, et al., 2013). However, while it was hypothesized that emotion recognition/identification would be negatively related to scores on the Difficulties in Emotion Regulation Scales (DERS) and the Inventory of Interpersonal Problems (IIP-64), no observed relationship between accuracy at identifying the negative emotion, DERS total scores, and IIP-64 total scores were revealed for either group. There was a moderate negative relationship between two of the DERS subscales, one of the IIP-64 subscales and accuracy at identifying the masked emotions. However, the relationships varied as a function of smile type and group type. Overall, no clear patterns in the relationships were revealed between DERS and IIP-64 total or subscale scores and accuracy at identifying the masked negative emotions. Therefore, while it has been proposed that the ability to recognize emotions in others is related to emotion self-regulation and interpersonal functioning (Izard, 2001; Lane et al., 2001), this may not be true with regards to the identification of negative emotions within masking smile expressions. It could be argued that the ability to identify macroexpressions of emotion in others is more closely related to emotion dysregulation than the ability to identify masked emotions.

Interestingly, moderate relationships between total and subscale scores on both the DERS and IIP-64 and the judgment of smile authenticity (i.e., expected responses, and presence of another emotion) were revealed. However, these relationships were also

inconsistent and varied as a function of group, smile type, and subscale. Nevertheless, the fact that the results from the smile authenticity task were moderately related to many of the DERS and IIP-64 total and subscale scores indicates that perhaps there is a closer relationship between emotional and interpersonal functioning and the ability to distinguish smile authenticity than there is between emotional and interpersonal functioning and the identification of masked negative emotions when considering tasks of masking smile judgment. In other words, with respect to masking smile judgment, the ability to understand that an individual's smile is not authentic and is masking another emotion may be more related to (and perhaps more relevant to) emotion regulation and interpersonal functioning than the ability to actually identify the emotions being masked by the smile. The ability to distinguish authenticity of smile expressions would be adaptive for individuals, as psych-evolutionists would observe that the ability to correctly distinguish between enjoyment and masking smile expressions would allow for the correct interpretation of others' intent, thus further contributing to an individual's survival (Darwin, 1872; Plutchik, 2001). Future research should further explore the importance of and clarify the relationship between emotional and interpersonal functioning in the judgment of both macroexpressions and various types of microexpressions (including masking smile expressions) because the relationships might vary according to the types of expressions (e.g., macroexpressions vs. microexpressions) and the judgment tasks (e.g., authenticity task vs. emotion identification task).

4.7 Clinical Implications

Research indicates that the ability to accurately interpret emotional facial expressions is important for adaptive emotional and interpersonal functioning (Izard,

2001; Lane, et al., 2001; Marsh, et al., 2007; Wang, 2009). Individuals with SUDs have been shown to experience many difficulties in their ability to accurately interpret emotional facial expressions when compared to healthy individuals. Additionally, these individuals have been shown to experience significant interpersonal and emotional dysfunction. More importantly, these difficulties experienced by individuals with SUDs may pose problems for treatment. For instance, it has been reported that the interpersonal problems faced by individuals with alcoholism is a mediating source of their relapse (Marlatt, 1996; Zywiak et al., 2003). The results of the current study could then be used to inform the interpersonal and emotional skills that are taught to individuals with SUDs in treatment programs. For instance, the results indicated that the ability to distinguish smile authenticity may be more related to emotional and interpersonal functioning than the ability to identify the masked emotions. Therefore, it may be more important to teach them how to detect the presence of a microexpression than it is to teach them how to identify the exact emotion that leaked from the expression. This might also entail training individuals how to accurately attend to the area of the expression where the negative emotions may be present.

The treatment programs would most likely also benefit from training these individuals how to accurately identify the facial cues that are associated with negative emotions in hopes that it improves both their ability to identify macroexpressions and microexpressions of emotion. Additionally, understanding that these individuals experience negative biases in their interpretation of smile expressions could be used to inform counsellors and other clinicians who treat these individuals, because the misinterpretation of facial expressions may lead to interpersonal conflict, withdraw from

a treatment program, and potentially relapse. Future research should examine whether a brief emotional facial expression interpretation workshop could improve these individual's ability to accurately interpret emotional facial expressions and whether improvements in emotional facial expression recognition is related to greater interpersonal and emotional functioning.

4.8 Limitations

A first limitation of the current study was that the use of substances at the time of testing was not controlled for with regards to the experimental group (i.e., those with SUDs). Specifically, the female participants were recruited from an inpatient program and a continuing care program, while the males were recruited from an outpatient program. While the inpatient and continuing care clients are expected to remain abstinent from all substances, the male clients from the outpatient program follow a harm-reduction approach and therefore may have used substances around the time that testing occurred. While an exclusion criterion for participation in the current study was that clients did not use any substances that have an affect the ocular motor system, there were no specific measures in place other than self-report, that would have ensured that participants were not taking any of these substances prior to testing. Research indicates that the deficits individuals with SUDs experience with respect to emotional facial expression recognition occurs in both recently detoxified individuals as well as long term abstinent individuals (Foisy et al., 2007; Kornreich et al., 2001), however, future research should attempt to strictly control for this factor to better understand the specific effect of substance use on smile judgment.

A second limitation was that it was not possible to have consistent smile expression stimuli as it pertains to open or closed mouths because some of the encoders of the smile expressions were either unable to activate specific muscular movements of the face without opening the mouth (AU 25) or without keeping the mouth closed. Therefore, some of the smile prototypes in the current study entailed the opening of the mouth (AU 25) and others did not. However, this is consistent with past literature that indicates that voluntarily controlling and activating specific facial muscles of the face can be extremely difficult (e.g. see Gosselin, Perron, & Beaupre, 2010). The inconsistency in an open or closed mouth could have affected the results in that individuals' attention might have been directed more so towards the mouth region of the expression depending on whether it was open or closed. However, the results of the current study indicated that individuals most often focused their attention towards the eye region of the face across every expression, regardless of a closed or open mouth. Nevertheless, future research should ensure consistency and equally control for of the muscular activations within the smile expression stimuli.

4.9 Conclusion

The current study examined the judgments individuals with SUDs make regarding the authenticity of enjoyment smiles and masking smiles containing traces of negative emotions. Their ability to identify the emotions were also investigated. Eye movements were recorded as it had yet to be explored, and the relationship between these judgments and interpersonal and emotional functioning were explored. The results provided further support for a deficit in emotional facial expression recognition as they showed that individuals with SUDs also experience difficulty in their judgment of smile authenticity

and identification of masked negative emotions. Eye-movement patterns suggest that individuals do not differentially attend to the part of the expression where the negative emotion is presented, a strategy that may have benefited them. However, no clear link between attentional processes and smile judgment were noted for either group. Finally, judgments regarding smile authenticity may be related to interpersonal and emotional functioning. The relationship between smile authenticity judgment, attentional processes, and interpersonal-emotional functioning should continue to be explored for this population as the results of the current study suggest the existence of extremely complex relationships.

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